AMPHIBIAN RESEARCH AND MONITORING INITIATIVE
Northeast Region

WOOD FROG AND SPOTTED SALAMANDER DOUBLE-OBSERVER EGG MASS COUNT PROTOCOL

Conceived by Evan H.C. Grant, Priya Nanjappa, James D. Nichols, and Robin E. Jung
USGS Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD 20708
301.497.5842, evan_grant@usgs.gov
301.497.5811, priya_nanjappa@usgs.gov
301.497.5875, robin_jung@usgs.gov
FAX: 301.497.5784

INTRODUCTION

Concerns over amphibian declines and malformations have necessitated increased monitoring efforts for amphibians (Heyer et al. 1994, Olson et al. 1997). Vernal pools are an essential habitat for amphibians and other organisms such as fairy shrimp, Blanding's turtles, and spotted turtles in the northeastern United States. Vernal pools have typically received little or no protection, are easily overlooked, and are often degraded or destroyed when they are dry (Hunter et al. 1999). Because vernal pools are susceptible to degradation and loss, amphibians reliant on these wetlands are particularly vulnerable (Vial and Saylor 1993). Currently, several states in the northeastern United States (Massachusetts, New Hampshire, Maine) have recognized this problem and are identifying, documenting and certifying vernal pools (Kenney 1995, Tappan 1997, Calhoun 1999, Kenney and Burne 2000). For these state programs, volunteers record whether spotted, Jefferson, and blue-spotted salamanders and wood frogs (chorusing, amplectant pairs, egg masses, larvae) are present in vernal pools.

The protocol described herein will help to address the following questions at a regional scale: Are the numbers of wood frog and spotted salamander egg masses:

1) increasing, decreasing or staying the same over time?
2) related to surrounding land use and cover, road density or distance to nearest road, and proximity to or density of other potential breeding sites?
3) related to water quality variables, hydroperiod, or climatic conditions?

We will also be able to address whether the detectability of egg masses varies in relation to environmental and survey factors (e.g., pool depth, observer, etc.).

WOOD FROGS AND SPOTTED SALAMANDERS

Petranka (1998) recommends focusing on spotted salamanders (*Ambystoma maculatum*) for long-term amphibian monitoring programs because they are so widespread, well-studied, and can serve as an indicator species for the health of vernal pool-forest ecosystems. Ambystomatid salamanders (mole salamanders) require both wetlands (usually vernal pools) for breeding and surrounding upland woodlands for survival where they spend about 95% of their lifetime burrowed underground (Semlitsch 1998). Protecting these wetlands as well as a 164-250 m radius of deciduous forest around them is critical for maintaining healthy populations of ambystomatids (Robinson 1995, Petranka 1998, Semlitsch 1998). In a landscape context, it is also critical that forest corridors connecting vernal pools or stepping-stone vernal pools are available to

maintain metapopulations (Gibbs 1993). According to Petranka (1998, p. 87), "local populations of this and other *Ambystoma* populations are becoming increasingly isolated from one another as habitat fragmentation, deforestation and loss of vernal pools reduce gene flow among demes" as well as reduce the ability of salamanders to recolonize areas where populations may have gone extinct. Spotted salamander populations have been declining over the past decade in eastern Virginia, and acid deposition and associated metal toxicity may play a role in these declines (Freda and Dunson 1986, Blem and Blem 1989, 1991, Freda et al. 1991). In Pennsylvania, the number of spotted salamander eggs in a vernal pool was correlated with pH and pond size, and negatively correlated with total cations and silica (Rowe and Dunson 1993). However, Cook (1983) surveyed 13 ponds in Massachusetts and found no relationship between spotted salamander embryonic mortality and pond pH. Turtle (2000) found that deicing salts used for highway maintenance contaminated roadside vernal pools and were a possible factor in reduced embryonic survival in these pools compared to pools away from roads. Roads are known to have deleterious effects on amphibians through direct mortality or as potential barriers to movement (Fahrig et al. 1995). Egan (2001) reported that egg mass numbers of spotted salamanders decreased when road density exceeded 19 m/ha.

Wood frogs, which also breed in vernal pools and are explosive breeders, may also be good indicators of the health of vernal pool ecosystems and metapopulation landscape issues (Guerry and Hunter 2002). Crouch and Paton (2000) found that egg mass counts of wood frogs is an effective means to monitor wood frog populations, as it is a relatively accurate and precise survey technique. They found that egg mass counts were highly correlated with numbers of females and males entering a pool. Wood frogs are vulnerable to acidification, habitat destruction and fragmentation (Gibbs 1998a,b), and runoff from highway road salt (Hunter et al. 1999). For example, deMaynadier and Hunter (1998, 1999, 2000) showed that wood frogs and other amphibian species were less abundant where clear-cutting had created abrupt edges and reduced canopy cover and ground leaf litter around vernal pools. Clear cutting edge effects can occur up to 35 m (115 feet) – vernal pools with a forest buffer less than this are typically abandoned as breeding sites by wood frogs and other amphibians. Wood frog and spotted salamander egg development can be impacted by runoff of salt applied to highways after late spring ice storms (Hunter et al. 1999, Turtle 2000). Egan (2001) reported that wood frog egg mass counts decreased when road density exceeded 12 m/ha.

DOUBLE-OBSERVER EGG MASS COUNT PROTOCOL (see also "Detailed Field Methods" below)

Each of the focal pools should be monitored closely to determine the best time to conduct the egg mass counts. Our goal is to obtain counts when the MAXIMUM number of wood frog and/or spotted salamander eggs are present at the pool, allowing us to get the best picture of the **overall cumulative reproductive output** for each vernal pool. **This will require conducting the egg mass counts THREE TIMES (twice is the bare minimum) ONE OR TWO WEEKS APART (again, depending on the weather) around or just after you observe maximal wood frog and spotted salamander breeding activity. Therefore, unlike the 2003 season, conduct FULL COUNTS regardless of whether the numbers of egg masses seem to be less than a previous day's count.** Aborted counts in 2003 resulting in less than two full egg mass counts at some pools adversely affected our data analysis.

Below are rough recommended sampling timeframes. There can be considerable annual variation in breeding times, and even within a given Park or Refuge, the breeding phenology can vary quite a bit among vernal pools only kilometers apart. The most important thing is to be attuned to the weather. Wood frogs and spotted salamanders migrate to ponds in the late winter or spring to breed on rainy or foggy nights when night air temperatures are above 10-12ºC. Often, wood frogs call during the daytime as well.

Park/Refuge	**State**	**Sampling Timeframe**
Erie	PA	22 Mar – 3 May
Patuxent	MD	21 Feb – 4 April
Acadia, Rachel Carson, Moosehorn, Lake Umbagog	ME, NH	4 April – 23 May
Cape Cod, E. Massachusetts	MA	21 Mar – 2 May
Great Swamp, Wallkill River, Iroquois	NJ, NY	21 Mar – 2 May
Rock Creek	D.C., MD	19 Mar – 30 April
Shenandoah, Canaan Valley	VA, WV	7 Mar – 18 April

The FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET 2004 has a grid for mapping the vernal pool and egg mass area locations. It is best to Xerox these data sheets onto Rite-in-the-Rain paper. Egg mass counts are best conducted during the day when the sun is out (9 am – 3 pm). During late afternoon hours (4 pm on) or during heavy cloud cover, visibility may be impaired and egg masses may be more difficult to detect, particularly in vernal pools that are stained by tannic acid from decaying leaves. Both observers should start at the **same point of the pond for every visit** and should circumnavigate the pond together in a clockwise fashion. Use polarized glasses to minimize sun glare and to aid in detection of egg masses. Use a visual/tactile method to count egg masses, using eyes and hands (e.g., cupping hands under the egg mass) to count the egg masses in the pool. It is extremely important to try not to disturb or dislodge the egg masses during the survey. Walk very slowly through the entire pond to minimize disturbance. Most egg masses are near the edges of pools, but egg masses can also be in the middle of shallow pools.

The **DOUBLE-OBSERVER DEPENDENT** (Cook and Jacobson 1979, Nichols et al. 2000) technique is described as follows: OBSERVER 1 counts and points out egg masses to OBSERVER 2. OBSERVER 2 records what OBSERVER 1 reports, but also writes down in a separate column any additional egg masses that OBSERVER 1 missed or over-counted (see Detailed Field Methods below). OBSERVER 2 DOES NOT MAKE ANY COMMENTS TO OBSERVER 1 ABOUT THE COUNTS. The Double-Observer Dependent method allows calculation of detection probabilities for each observer, thus providing adjusted population estimates for the number of egg masses in the pools (Cook and Jacobson 1979, Nichols et al. 2000). **IT IS VERY IMPORTANT FOR OBSERVERS TO SWITCH ROLES HALF-WAY AROUND THE VERNAL POOL.** For example, if Woody Frog is Observer 1 for the first half at the pool, then he should be Observer 2 for the second half of the pool. Indicate when Observers switch roles on the data sheet by drawing a line under the last row of data before the switch (see example data sheet).

LITERATURE CITED

Blem, C.R., and L.B. Blem. 1989. Tolerance of acidity in a Virginia population of the spotted salamander, *Ambystoma maculatum* (Amphibia: Ambystomatidae). Brimleyana 15:37-45.

Blem, C.R., and L.B. Blem. 1991. Cation concentrations and acidity in breeding ponds of the spotted salamander, *Ambystoma maculatum* Shaw (Amphibia: Ambystomatidae), in Virginia. Brimleyana 15:67-76.

Calhoun, A. 1999. Maine Citizen's Guide to Locating and Documenting Vernal Pools. Maine Audubon Society. 98 pp.

Cook, R.P. 1983. Effects of acid precipitation on embryonic mortality of *Ambystoma* salamanders in the Connecticut Valley of Massachusetts. Biological Conservation 27:77-88.

Cook, R.D., and J.O. Jacobson. 1979. A design for estimating visibility bias in aerial surveys. Biometrics 35:735-742.

Crouch, W.B., and P.W.C. Paton. 2000. Using egg-mass counts to monitor wood frog populations. Wildlife Society Bulletin 28:895-901.

deMaynadier, P.G., and M.L. Hunter, Jr. 1998. Effects of silvicultural edges on the distribution and abundance of amphibians in Maine. Conservation Biology 12:340-352.

deMaynadier, P.G., and M.L. Hunter, Jr. 1999. Forest canopy closure and dispersal by pool-breeding amphibians in Maine. Journal of Wildlife Management 63:441-450.

deMaynadier, P.G., and M.L. Hunter, Jr. 2000. Road effects on amphibian movements in a forested landscape. Natural Areas Journal 20:56-65.

Egan, R.S. 2001. Within-pond and landscape-level factors influencing the breeding effort of Rana sylvatica and Ambystoma maculatum. M.S. Thesis in Environmental Sciences, University of Rhode Island.

Fahrig, L., J.H. Pedlar, S.E. Pope, P.D. Taylor, and J.F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73:177-182.

Freda, J., and W.A. Dunson. 1986. Effects of low pH and other chemical variables on the local distribution of amphibians. Copeia 1986:454-466.

Freda, J., W.J. Sadinski, and W.A. Dunson. 1991. Long term monitoring of amphibian populations with respect to the effects of acidic deposition. Water, Air, and Soil Pollution 55:445-462.

Gibbs, J.P. 1993. Importance of small wetlands for the persistence of local populations of wetland-associated animals. Wetlands 13:25-31.
Gibbs, J.P. 1998a. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. Journal of Wildlife Management 62:584-589.
Gibbs, J.P. 1998b. Distribution of woodland amphibians along a forest fragmentation gradient. Landscape Ecology 13:263-268.
Guerry, A.D., and M.L. Hunter, Jr. 2002. Amphibian distributions in a landscape of forests and agriculture: an examination of landscape composition and configuration. Conservation Biology 16:745-754.
Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L.C. Hayek, and M.S. Foster. 1994. Measuring and monitoring biological diversity: Standard methods for amphibians. Smithsonian Institution Press, Washington, D.C.
Hunter, M.L., Jr., A.J.K. Calhoun, and M. McCollough. 1999. Maine Amphibians and Reptiles. The University of Maine Press, Orono, ME.
Kenney, L.P. 1995. Wicked big puddles: A guide to the study and certification of vernal pools. U.S. Government Printing Office, Washington, D.C.
Kenney, L.P., and M.R. Burne. 2000. A field guide to the animals of vernal pools. Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program and Vernal Pool Association. Westborough, MA.
Nichols, J.D., J.E. Hines, J.R. Sauer, F. Fallon, J. Fallon, and P.J. Heglund. 2000. A double-observer approach for estimating detection probability and abundance from avian point counts. The Auk 117:393-408.
Olson, D.H., W.P. Leonard, and R.B. Bury. 1997. Sampling Amphibians in Lentic Habitats. Society for Northwestern Vertebrate Biology, Olympia, Washington.
Petranka, J.W., C.K. Smith, and A.F. Scott. 1995. Final Report: Implementation of a plan for long-term monitoring of amphibians in selected parks of the southeast region. National Park Service Report. Cooperative Agreement No. CA-5140-1-9001.
Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C.
Robinson, A. 1995. Small and seasonal does not mean insignificant: why it's worth standing up for tiny and temporary wetlands. J. Soil and Water Conservation 50:586-590.
Rowe, C.L., and W.A. Dunson. 1993. Relationships among abiotic parameters and breeding effort by three amphibians in temporary wetlands of central Pennsylvania. Wetlands 13:237-246.
Semlitsch, R.D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1113-1119.
Tappan, A. 1997. Identification and documentation of vernal pools in New Hampshire. New Hampshire Fish and Game Department, Nongame and Endangered Wildlife Program,
Turtle, S.L. 2000. Embryonic survivorship of the spotted salamander (*Ambystoma maculatum*) in roadside and woodland vernal pools in southeastern New Hampshire. Journal of Herpetology 34:60-67.
Vial, J.L., and L. Saylor. 1993. The Status of Amphibian Populations: A Compilation and Analysis. ICUN/SSC Declining Amphibian Populations Task Force Working Document No. 1. 98 pp.

STUDY SITES AND PARTICIPANTS IN 2004

Below are the participating National Parks, National Wildlife Refuges, and State Parks and biologists and the vernal pools where we will be conducting double-observer egg mass counts in 2004. The vernal pools below are those that have been monitored continuously since 2001 or 2002.

UNIT	*BIOLOGIST*	*VERNAL POOLS*
Acadia National Park, ME	Bruce Connery	Western Mountain Road N
		Gorge Trail VP (165)
Cape Cod National Seashore, MA	Robert Cook	E21
		W15
Canaan Valley NWR, WV	Ken Sturm	FR80 Quarry Pool
		Beall Cabin Woods
Canaan Valley State Park, WV	John Northeimer	Back Hollow
		Lodge Pond
		North Gravel Pit
Erie NWR, PA	Norma Kline	Juice Pool
		Batch's Pool
Eastern Massachusetts NWR, MA	Stephanie Koch	Kettle Hole Pool
		Triple Pool
		Rona's Pool
Great Swamp NWR, NJ	Michael Horne	Harding Landfill
		MCOEC Pool
Iroquois NWR, NY	Paul Hess	Horseshoe Pool
		Onondaga Pool
Lake Umbagog NWR, NH	Laurie Wunder	Day Flats
		Errol Hill 1
		Errol Hill 2
		Little Berlin
Moosehorn-Baring NWR, ME	Maurice Mills	Barn Meadow (site 1)
		McConvey (site 3)
Patuxent Research Refuge, MD	Robin Jung	Sam's Pond
		Blue Road
		Red Road
Rachel Carson NWR, ME	Kate O'Brien	Kate's Pond
		Rachel's Pond
Rock Creek Park, DC	Robin Jung	Parkside Pool
		West Beach Pool
		Weir Pool
		Riley Springs Pool
Shenandoah National Park, VA	Robin Jung	Big Meadows
		Hogcamp Swamp
Walkill River NWR, NJ	Kevin Holcomb	Scenic Lakes Rd. N 1
		Wood Duck Nature Trail 2
USDA BARC, MD	Robin Jung	Shumate
		Entomology 2
		Powerline
		Laura's Pond

DETAILED FIELD METHODS:

Before beginning field work for this project, please check your GPS receivers and ensure that they are set up to take points as follows (if possible, use a Garmin GPS III+ Personal Navigator):
Datum: North American Datum 1983 (often abbreviated as NAD 83)
Spheroid: Geodetic Reference System of 1980 (often abbreviated as GRS 1980 or GRS80)
Format: **Degrees, Minutes, Decimal Seconds (DDMMSS.SS)**

1) When you first arrive at the focal vernal pool, record the Unit (Refuge or Park) name, the vernal pool name, and the date on both sides of the FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET 2004. Without entering the pool so as to avoid disturbing egg masses in the pool, measure the pool maximum length and maximum width and record these as indicated on the data sheet. Use these measurements to help you draw the focal vernal pool onto the provided grid on the front of the data sheet, and to determine and record your grid spacing. Include landmark features (e.g., fallen trees, islands) in your drawing to help you orient your placement of egg mass locations on the map.
2) On the back of the FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET 2004, record the Sky Code, Wind Code, Previous Day Precipitation, Water Temperature, and pH (see Variable Definitions for explanations).
3) Record the full names of Observer 1 and Observer 2, and when you are ready to begin the survey, record your Time Begin as indicated on the data sheet. Observer 1 will count masses first while Observer 2 records data.
4) Both Observers should walk side-by-side, heading in a clockwise direction around the pool.
5) When egg masses are encountered, Observer 1 determines the area encompassing the masses that he/she will count. This area should be labeled on the grid as well as under "Species" in the data columns below the grid. If Observer 1 observes wood frog egg masses, label these as "W*n*" where W represents 'wood frog' and *n* is a sequential number (e.g., W1, W2, etc.). Similarly, if Observer 1 observes spotted salamander eggs, this area should be labeled as "S*n*" where S represents 'spotted salamander' and *n* is a sequential number (e.g., S1, S2, etc.).
6) Once the area has been designated, Observer 1 should count the egg masses, using both visual and tactile methods, and count out loud, showing each egg mass to Observer 2. Observer 2 should not comment on the accuracy of Observer 1's counts. In the data column marked "OBS 1" under "# Egg Masses", Observer 2 should record the number of egg masses counted by Observer 1, and record any egg masses that were either missed or over-counted in the "OBS 2" data column. For example, if Observer 1 counts 10 masses, but Observer 2 counts 12, then record "10" under OBS 1 and "+2" under OBS 2. If Observer 1 counts 10 masses, but Observer 2 counts only 7, then record "10" in OBS 1 and "-3" in OBS 2.
7) Once Observers have reached the half-way point around the pool, they should switch roles (Observer 1 records while Observer 2 counts). Also indicate on the data sheet when the switch occurred by drawing a line under the last data row before the switch. Repeat as in steps #6-8 until the survey is complete.
8) At the end of the survey, record your Time End and check whether or not visibility was impaired due to heavy cloud cover, heavily stained water due to tannins, or siltation or vegetation.
9) Record any other amphibian, reptile or other species observed during the survey in the Table provided, and any pertinent notes in the NOTES box.
10) On your first visit to the pool, **after completing the double-observer count survey,** take 2 near-shore measurements within 3 meters of the pool edge along each end of the max length and max width (i.e., use meter tape to find max length, record 2 measurements at one end of the tape, and 2 measurements at the opposing end of the tape; repeat for max width) for a total of 8 depth measurements. The location of the measurements will vary by pool, and so it is important that the linear distance along the meter tape (along the length or along the width) is recorded on the datasheet (e.g., max length is measured at 20m; along this, depth #1 is 10 cm at 1.5m, depth #2 is 20 cm at 2.5 m, depth #3 is 15 cm at 17.5m, and depth #4 is 6 cm at 18.5m). Although these

measurements only need to be done on your first visit to the pool, a maximum depth measurement should be taken at approximately the same point EACH time you visit the pool. **Record pool maximum depth in cm as indicated on the data sheets. Be very careful not to dislodge or disturb egg masses while you measure pool depths.**

11) After completing the double-observer count survey, record vernal pool depths at four equally-spaced locations along the maximum length and maximum width of the pool take 2 measurements within 3 meters of the pool edge along the max length and max width (i.e. 2 measurements near-shore along each end of the meter tape), for a total of 4 depth measurements. This only needs to be done the first time you visit the pool, while a maximum depth measurement should be taken each time you visit the pool at approximately the same spot. Also Record pool maximum depth in cm as indicated on the data sheets. **The location of the measurements will vary by pool, and so it is important that the location along the linear distance across the pond (along the length or along the width) is recorded**. Be very careful not to dislodge or disturb egg masses while you measure pool depths.
12) After your first double-observer count survey at a Focal Vernal Pool in the calendar year season, fill out a FOCAL VERNAL POOL LOCATION AND HABITAT DATA SHEET. Record the Unit (Refuge or Park name), Vernal Pool Name, the full name of the Observer filling out the data sheet, and the date in DD Month format (e.g., 12 March). Write in detailed directions to the vernal pool site. Next, record Latitude and Longitude, and be sure to include your estimated position error (EPE) in meters. Make sure that your GPS is set up with Datum as North American Datum (NAD) 1983, and that points are displayed as DDMMSS.SS format. We cannot accept UTM coordinates. See Variable Definitions for instructions to fill out the remainder of this data sheet.

FIELD EQUIPMENT NEEDED

Data sheets:
- Focal Vernal Pool Egg Mass Count Data Sheet 2004
- Focal Vernal Pool Location & Habitat Data Sheet

Protocol & Rite-in-the-Rain paper
Clipboard & Pencils
Digital Camera or Regular Camera
Polarized Sun Glasses (2)
50 m fiberglass meter tape
Thermometer for air and water temperatures
Dowel Rod 48" x 5/8" (1 per focal vernal pool) & Rubber Mallet (to pound in dowel rod if necessary)
Field Guides [Kenney and Burne; Conant and Collins (Peterson Series)]
Compass
Watch
Meter stick
GPS Unit/PLGR (1)
Sharpies & Flagging Tape

VARIABLE DEFINITONS (explanations of variables on all data sheets):

FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET 2004

Front Side of Data Sheet

UNIT: Name of Refuge or Park (e.g., Acadia National Park, Erie NWR)
VERNAL POOL NAME: Name of specific pool being surveyed (e.g., Sam's Pond, Rachel's Pond)
DATE: Write out DD MONTH (e.g., 24 March). Egg mass count surveys should be completed in one day (i.e., do not survey half the pool one day and finish it the next day).

TIME BEGIN: Use the 24 hour clock (e.g., use 13:20 = 1:20 pm). Write down the time the double-observer egg mass count survey begins. Begin and end times only cover the time actually spent searching for and counting egg masses and recording other organisms, not time spent collecting habitat or environmental data.
TIME END: Use 24 hour clock (e.g., use 15:00 = 3:00 pm).
GRID SPACING IS: Indicate the distance in meters between the lines on the grid. This necessitates measuring the maximum length and width of the pond BEFORE you begin the survey, so that you have a more accurate site map. Indicate the direction North with an N and arrow on the map.
OBSERVER 1: Write down the full name of OBSERVER 1 (the person who starts out the survey as Observer 1; e.g., Bruce Connery).
OBSERVER 2: Write down the full name of OBSERVER 2 (the person who starts out the survey as Observer 2).
SPECIES: Use **W** for wood frog and **S** for spotted salamander egg mass areas. As you circumnavigate around and in the pond, label wood frog egg mass areas as **W1, W2, W3,** etc. Label spotted salamander egg mass areas as **S1, S2, S3,** etc. Observer 1 determines what constitutes an egg mass area. Put these in the species column with corresponding Observer 1 and 2 counts.
 # EGG MASSES OBS 1: Observer 2 records the number of egg masses Observer 1 sees within an egg mass area.
 # EGG MASSES OBS 2: Observer 2 records any egg masses that were either missed or over-counted by Observer 1. For example, if Observer 2 sees that Observer 1 missed 5 egg masses, Observer 2 records "+5" in the OBS 2 column. If Observer 2 sees that Observer 1 over-counted 4 egg masses, Observer 2 records "-4" in the OBS 2 column.
Back Side of Data Sheet
UNIT: same as above
VERNAL POOL NAME: same as above
DATE: same as above
SKY CODE: Do not conduct surveys if sky codes are 6 or above!! The codes are as follows:

Code	Sky Condition
0	Clear or few clouds (< 20% of sky)
1	Partly cloudy or variable (20-50% of sky)
2	Cloudy or overcast (> 50% of sky)
3	Fog
4	Mist
5	Showers or light rain
6	Heavy rain
7	Sleet/Hail
8	Snow

WIND CODE: Do not conduct surveys if wind codes are 6 or above!! The codes are as follows:

Code	mph	Indicators of Wind Speed
0	< 1	calm, smoke rises vertically
1	2-3	light air movement, smoke drifts
2	4-7	light breeze, wind felt on face, leaves rustle
3	8-12	gentle breeze, leaves/twigs in constant motion, raises dust
4	13-18	moderate breeze, small branches move
5	19-24	fresh breeze, small trees begin to sway
6	25-31	strong breeze, large branches move
7+	> 31	strong winds

PREVIOUS DAY PRECIPITATION: Was there substantial ($\geq$ 1 cm) precipitation the day prior to the survey? This information is useful for determining the likelihood of amphibian migration to breeding pools. Check one of the boxes as to whether substantial precipitation did (Yes) or did not (No) occur in the past 24 hours.
WATER TEMP.: Collect water temperature in the shade within a meter from the edge of the pool, holding the thermometer 10 cm underwater. Check the box to indicate either Centigrade or Fahrenheit scale.

pH: Collect water sample in your plastic beaker/sampling container from an area near egg masses and where the container can be fully submerged, if possible, and use your pH probe/meter to record pH.
POOL MAXIMUM LENGTH: Length of pool at maximum length; record using meter tape (e.g., 14.2 m).
POOL MAXIMUM WIDTH: Width of pool at maximum width; record using meter tape (e.g., 5.5 m).
POOL MAX. DEPTH: Depth of pool at deepest depth. Install a dowel rod (5/8" x 48") where you estimate it to be the deepest part of the vernal pool. Each time you visit the site, wade out to the dowel rod to record the water depth at that location. Record in centimeters using a meter stick.
DEPTHS ALONG MAX WIDTH (cm): Record four pool depths, in cm, with 2 measurements within 3 m of the pool edge on each end along the maximum width.
At Linear Distance (m): Linear distance associated with each of 4 depth measurements. For example, if first depth is 10 cm, taken at 1.5 m from shore, record "10 cm" for depth, and record "1.5 m" for associated linear distance; repeat for remaining measurements.
DEPTHS ALONG MAX LENGTH (cm): Record four pool depths, in cm, with 2 measurements within 3 m of the pool edge on each end along the maximum width.
At Linear Distance (m): Linear distance associated with each of 4 depth measurements. For example, if first depth is 10 cm, taken at 1.5 m from shore, record "10 cm" for depth, and record "1.5 m" for associated linear distance; repeat for remaining measurements.
IS VISIBILITY IMPAIRED DURING EGG MASS COUNTS?: Check Yes or No, if visibility is impaired, for example, by excessive water cloudiness (silt) or darkness (tannic acids), etc.
OTHER AMPHIBIANS, REPTILES, INVERTEBRATES, ETC.: For Amphibian and Reptile species, write in the species observed and estimate the numbers of mated pairs, egg masses, juveniles or adults observed, or check whether spermatophores or tadpoles/larvae were seen. Please include **ALL vertebrates or invertebrates** that were seen at the pool (consult "A Field Guide to the Animals of Vernal Pools"). If frogs or toads were heard calling, write in which species were chorusing and use the Chorus Codes below. For Chorus Code 3, simply record 3. For Chorus Codes 1 and 2, record the Chorus Code as well as an Abundance Count in parentheses following it. For example, if you hear a spring peeper chorus code of 2 and estimate 6 individual spring peepers calling, write down Spring Peeper under Species and 2(6) under Chorus Code.

Chorus Code	**Description**
0	No amphibians calling.
1	Individuals can be counted, calls not overlapping. Assign this number when individual males can be counted, and when the calls of individuals of the same species do not overlap. For the *Abundance Count*, record the number of individual frogs of each species calling.
2	Calls distinguishable, some simultaneous calling. This code is assigned when there are a few males of the same species calling simultaneously. However, with a little work, individual males can still be distinguished. The exact number of individuals may not be determined, but a reliable estimate of the number of individuals can be determined based on the location of the calls and/or by differences in the voices calling. Therefore the *Abundance Count*, is an estimate of the number of individuals calling.
3	Full chorus, calls continuous and overlapping. This value is assigned when there are so many males of one species calling that all the calls sound like they are overlapping and continuous. There are too many overlapping calls to allow for any reasonable count or estimate, therefore an *Abundance Count* is not recorded.

NOTES: In this section include any other observations of interest. Also, if you run out of room on the front part of the data sheet, you can use this section for additional data collection on egg mass numbers.

FOCAL VERNAL POOL LOCATION AND HABITAT DATA SHEET

This data sheet only needs to be filled out **ONCE** at each of the FOCAL VERNAL POOLS the first time you conduct a double-observer egg mass count at the vernal pool. Please **TAKE PHOTOGRAPHS** of the vernal pool at this time.

UNIT: same as above
VERNAL POOL NAME: same as above
OBSERVER: same as above
DATE: same as above
DETAILED DIRECTIONS TO SITE: Describe the specific geographic location of the site. Use air distance in two directions (e.g., 5 km N and 7.5 km W) of a map landmark that likely will not change (e.g., "500 m NW from American Holly Drive 0.2 km W of gate entrance").
LATITUDE: Record as degrees minutes and decimal seconds (DDºMM'SS.SS").
LONGITUDE: Record as degrees minutes and decimal seconds (DDºMM'SS.SS").
EPE: Record estimated position error in meters, usually displayed on a GPS device. Important!
POOL MAXIMUM LENGTH: see above
POOL MAXIMUM WIDTH: see above
POOL MAXIMUM DEPTH: see above
POOL PERMANENCY: Check if pool is temporary, semipermanent, or permanent.
POND TYPE: Check if pool is Natural, Beaver-created, Artificial/Man-made, or Unknown. If Artificial/Man-made, check the box that best applies (e.g., borrow pit, roadside ditch, etc.).
SITE TYPE: Classify site type by whether it is upland-isolated, bottomland-isolated, or part of a wetland complex. Check the box that best applies.
FISH PRESENT: Record if fish are absent (No) or present (Yes). If Yes, record species observed.
DISTANCE TO FOREST FROM WATER'S EDGE: estimate the nearest distance to forest. You may do this by pacing, but be sure to record the value in meters (m).
DISTANCE TO NEAREST ROAD: estimate the nearest distance to a road. You may do this by pacing, but be sure to record the value in meters (m).
ROAD TYPE: Check whether road is paved, gravel, or dirt.
ROAD CONDITIONS AT NIGHT: Record whether nearest road to site experiences only use by Park/Refuge personnel, or light (< 10 cars) or heavy ($\geq$ 10 cars) traffic at night.
AQUATIC SUBSTRATE: Record abundance categories (0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%) for leaf litter and sticks/logs which are found in or cover the bottom of the pool (these do not sum to 100%).
AQUATIC VEGETATION: Estimate the percent cover of SAV, Emergent, Shrub, and Tree in the pool. Record as abundance categories (0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%):

SAV (Submerged Aquatic Vegetation)
Emergent (e.g., sedges, rushes, arrowhead, cattail, waterlilies; includes surface veg. like duckweed)
Shrub
Tree

LAND USE/COVER AROUND VERNAL POOL: Estimate % of each land use/cover types within 50 m (165 ft) of pool. Estimates must sum to 100%.

% Woodland/Forest – If woodland/forest surrounds vernal pool, check whether it is dominated by hardwood, softwood, or mixed forest. Also check whether canopy cover over the vernal pool is heavy (>50%) or moderate (<50%).
% Agriculture/Fields/Meadow/Pasture
% Developed:Urban/Suburban/Residential/Mining/Industrial
% Road/Right-of-Way
% Other (specify other if this applies)

NOTES: Include any observations about the site you think pertinent.

FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET 2004

UNIT (Refuge/Park): ________________________

VERNAL POOL NAME: ________________________

DATE (DDMonth): ___________________ **2004**

TIME BEGIN:___________

TIME END: _____________

GRID SPACING IS ________ m
INDICATE North ON MAP

OBSERVER 1 (full name) ____________________________

OBSERVER 2 (full name) ____________________________

INDICATE WITH LINE WHEN OBSERVERS SWITCH

Species	# Egg Masses OBS 1	OBS 2	Species	# Egg Masses OBS 1	OBS 2	Species	# Egg Masses OBS 1	OBS 2

UNIT (Refuge/Park): _____ **VERNAL POOL NAME:** _____

Date (DD Month): _____2004 Sky Code: _____ Wind Code: _____ Previous Day Precipitation? ☐ YES ☐ NO

Water Temp.: _____ ☐ ºC ☐ ºF Water pH: _____

Pool Max. Length: _____ m Pool Max. Width: _____ m

Pool Max Depth: _____ cm

Along Max Length

Depth				
at linear distance				

Along Max Width

Depth				
at linear distance				

Is Visibility Impaired During Egg Mass Counts? ☐ YES ☐ NO

OTHER AMPHIBIANS, REPTILES, INVERTEBRATES, ETC.:

SPECIES	Chorus Code	# Mated Pairs	Sperma-tophores	# Egg Masses	Tadpoles/ Larvae	# Juveniles	# Adults

NOTES:

CHORUS CODE	DESCRIPTION
0	No amphibians calling
1	Individuals can be counted, calls not overlapping. Record number of individuals calling after code separated by hyphen (e.g., 1-3)
2	Calls overlap, but individuals are distinguishable. Record number of individuals calling after code separated by hyphen (e.g., 2–6)
3	Full chorus, calls continuous and overlapping. Can not distinguish individuals.

FOCAL VERNAL POOL LOCATION AND HABITAT DATA SHEET

UNIT: _____VERNAL POOL NAME: _____

OBSERVER: _____ DATE (DD MONTH): _____ 2004

DETAILED DIRECTIONS TO SITE:

LATITUDE (DDMMSS.SS): _____ LONGITUDE (DDMMSS.SS): _____ EPE: +/- ____m

POOL MAX. LENGTH: _____ m POOL MAX. WIDTH: _____ m POOL MAX. DEPTH: _____ cm

POOL PERMANENCY: ☐ temporary (dries annually) ☐ semipermanent (sometimes dries) ☐ permanent (never dries)

POND TYPE (Check either Natural, Beaver-created, Artificial/Man-made, or Unknown):

☐ Natural (e.g., oxbow, vernal pool)

☐ Beaver-created

☐ Artificial/Man-Made - If pool is artificial/man-made, pick best description below:

☐ borrow/gravel pit ☐ roadside ditch ☐ farm pond ☐ impoundment ☐ other: _____

☐ Unknown

SITE TYPE: ☐ upland-isolated (not part of larger wetland)

☐ bottomland-isolated (part of a river or lake floodplain)

☐ wetland complex (associated with a larger wetland complex)

FISH PRESENT: ☐ No ☐ Yes If Yes, list Species:_____

DISTANCE TO FOREST FROM WATER'S EDGE: _____ m

DISTANCE TO NEAREST ROAD: _____ m

ROAD TYPE: ☐ PAVED ☐ GRAVEL ☐ DIRT

ROAD CONDITIONS AT NIGHT: ☐ Refuge/Park use only ☐ Light Traffic (< 10 cars) ☐ Heavy Traffic (≥ 10 cars)

FOR THE FOLLOWING, RANK the amount of pond area in which each type occurs (does not need to sum to 100%): **0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%**

AQUATIC SUBSTRATE: Leaf Litter _____ Sticks/Logs _____

AQUATIC VEGETATION: SAV _____ Emergent _____ Shrub _____ Tree _____

LAND USE/COVER AROUND VERNAL POOL:

Estimate % of each of the land use/cover categories within 50 m of pool. Estimates should total 100%:

____ % Woodland/Forest

☐ Hardwood (> 75% deciduous)

☐ Softwood (> 75% evergreen)

☐ Mixed Hardwood/Softwood (< 75% each)

If % woodland/forest is entered, record if canopy cover over the vernal pool is heavy or moderate:

☐ Heavy (> 50% canopy cover of trees/shrubs > 6 ft. tall)

☐ Moderate (< 50% canopy cover of trees/shrubs < 6 ft. tall)

____ % Agriculture/Fields/Meadow/Pasture

_____% Developed: Residential/Urban/Suburban/Mining/Industrial

_____ % Road/Right-of-Way

_____% Other: _____

NOTES:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____